



The southernmost Miocene penguin (Aves, Spheniscidae) from South America

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With 1 figure

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Abstract: MLP 00-III-5-1 is a distal end of a right tibiotarsus belonging to a fossil penguin. It comes from the Cerro Águila Conglomerate (53°50'14.85"S, 67°47'29.78"W) near Río Grande City, Tierra del Fuego, Argentina. These beds overly sediments referable to the Cabo Peña Formation, probably similar in age to that of the Middle Miocene Carmen Silva Formation. The fossil described here is the only fossil penguin from this unit and represents the southernmost record of a Neogene penguin in South America.

Key words: Spheniscidae, Miocene, Cerro Águila Conglomerate, Patagonia, Argentina.

1. Introduction

Penguins constitute a group of marine birds exclusively distributed in the Southern Hemisphere. The oldest record belongs to *Waimanu manneringi* JONES et al., 2006, coming from the Early Paleocene strata of New Zealand (SLACK et al. 2006). In South America, the Paleogene records correspond to *Perudyptes devriesi* CLARKE et al. 2007, *Icadyptes salasi* CLARKE et al. 2007, and *Inkayacu paracacensis* CLARKE et al. 2010, all three coming from the Middle Eocene of Peru (CLARKE et al. 2007, 2010), a recent mention of isolated material assigned to *Palaeudyptes* sp. from the Middle Eocene of Chile (SALLABERRY et al. 2010) and the late Middle Eocene Pansphenisciformes of Argentina (CLARKE et al. 2003). These species did not survive beyond the Late Eocene or possibly the Oligocene. They

were replaced by more slender forms directly related with modern species (ACOSTA HOSPITALECHE 2006; ACOSTA HOSPITALECHE et al. 2007). This idea is supported by a rich Neogene record.

From the Early Miocene Gaiman Formation *Eretiscus tonni* (SIMPSON, 1981), *Palaeospheniscus bergi* MORENO & MERCERAT, 1891, *P. patagonicus* MORENO & MERCERAT, 1891 and *P. biloculata* (SIMPSON, 1970) are recorded. The contemporaneous Chenque Formation yielded *P. bergi* and *P. patagonicus*; whereas from the Early Miocene Monte León Formation only *Parapternodytes antarcticus* (ACOSTA HOSPITALECHE, 2006) is recorded.

Fossil penguins are also recorded from the Middle Miocene Puerto Madryn Formation, by *Madrynornis mirandus* (ACOSTA HOSPITALECHE et al., 2007) and *Parapternodytes antarcticus* (ACOSTA HOSPITALECHE,

2003); both stratigraphic units cropping out in Patagonia, Argentina. The genus *Palaeospheniscus* is recorded both from the Middle Miocene Chilcatay Formation of Peru and from the Late Miocene Bahía Inglesa Formation.

Spheniscus megaramphus STUCCHI et al., 2003 and *S. urbinai* STUCCHI, 2002 are species originally described for the Middle Miocene Pisco Formation (STUCCHI 2002; STUCCHI et al. 2003). More recently they were also recorded from the Bahía Inglesa Formation (CHÁVEZ 2008). Additionally from the latter unit are known *Pygoscelis calderensis* ACOSTA HOSPITALECHE et al., 2006 and *P. grandis* WALSH & SUÁREZ, 2006 (ACOSTA HOSPITALECHE et al. 2006; WALSH & SUÁREZ 2006).

From the Pliocene La Portada Formation only *S. chilensis* EMSLIE & GUERRA CORREA 2003 is recorded, a species that might be represented also in the Bahía Inglesa Formation (see CHÁVEZ 2008).

Systematic assignment of penguin remains is only possible from the characters of the tarsometatarsus, humerus and sometimes the skull. Anyway, the tibiotarsus MLP 00-III-5-1 studied herein becomes particularly interesting. It comes from the Lower Miocene of Tierra del Fuego (Argentina) and represents the first fossil penguin record from this area. The tibiotarsus described here represents the only evidence of Miocene penguins in this high latitude of Argentina.

2. Material and methods

The tibiotarsus MLP 00-III-5-1 was collected by one of the authors (L.S.), and is housed in the Museo de La Plata (MLP). Comparison material includes skeletons from the Museo de La Plata (also a cast from the American Museum of Natural History –AMNH–), Museo Argentino de Ciencias Naturales Bernardino Rivadavia (MACN), Centro Austral de Investigaciones Científicas (CADIC), Museo Paleontológico Egidio Feruglio (MEF-PV), Argentina; Museo de la Universidad de San Marcos (MUSM), Perú; Museo Nacional de Historia Natural (SGO-PV), Chile; Muséum National d'Histoire Naturelle (MNHN), France; and University of Florida (UF), USA.

Measurements were taken with a Vernier Caliper with 0.01 mm of increment and osteological terminology in descriptions follows BAUMEL & WITMER (1993).

3. Locality and age

The fossil MLP 00-III-5-1 comes from the Cerro Águila Conglomerate (53°50'14.85"S and 67°47'29.78"W), about 70 m from the bridge on Route 3 that crosses the Río Grande and some 8 km far from Río Grande City, Tierra del Fuego, Argentina (Fig. 1A). Cabo Peña, Cerro Águila Conglomerate, Carmen Silva and Cerro

Castillo formations are included in the Cabo Domingo Group (CODIGNOTTO & MALUMIÁN 1981; MALUMIÁN 1999; OLIVERO & MALUMIÁN 2008; Fig. 1B).

Historically, the Cerro Águila Conglomerates were referred to the Early Miocene (CODIGNOTTO & MALUMIÁN 1981), late Early Miocene (OLIVERO & MALUMIÁN 2008) or late Early-Middle Miocene (FELDMANN et al. 2011). The exact stratigraphic position of Cerro Águila Conglomerate is not clearly established yet; it overlies sediments referable to the Cabo Peña Formation and most probably they have an age similar to that of the Carmen Silva Formation (EDUARDO OLIVERO, pers. comm. 2011) which was deposited during the Middle Miocene (OLIVERO & MALUMIÁN 2008).

The Cerro Águila Conglomerate is composed of marine conglomerates and fossiliferous sandstones and was deposited at the beginning of a transgression that came from the Atlantic Ocean. It affected only the northern part of Tierra del Fuego Island. This transgression passes up into the deltaic sediments of the Carmen Silva and Castillo formations (CODIGNOTTO & MALUMIÁN 1981; ISLA & BUJALESKY 2004). The conglomerate yields calcareous concretions containing well-preserved decapod crustaceans, gastropods and bivalves (FELDMANN et al. 2011). For an updated and detailed discussion of the geology of Cerro Águila see FELDMANN et al. (2011).

4. Systematic palaeontology

Order Sphenisciformes SHARPE, 1891

Family Spheniscidae BONAPARTE, 1831

Spheniscidae gen. et sp. indet.

Fig. 1C

Material: MLP 00-III-5-1 (distal end of right tibiotarsus).

Comparative description: Damage to the shaft precludes exact estimation of cross-sectional shape in the specimen MLP 00-III-5-1, but taking into account the preserved portion, it seems sub-triangular in its more distal region. This feature is not comparable in *Perudyptes* because of its bad preservation. In the specimen CADIC P 21 this section is less compressed than in others Patagonian fossil species (CLARKE et al. 2003). It is more compressed anteroposteriorly in *Parapténodytes*, taking a semicircular shape with the flattened anterior or anterolateral face. Marked compression of the tibiotarsal shaft has been also noted for other fossil penguins (SIMPSON 1946, 1957).

The distal end of the shaft is bent medially like in *S. urbinai*, whereas it is remarkably straight (not medially deflected) in *S. muizoni*.

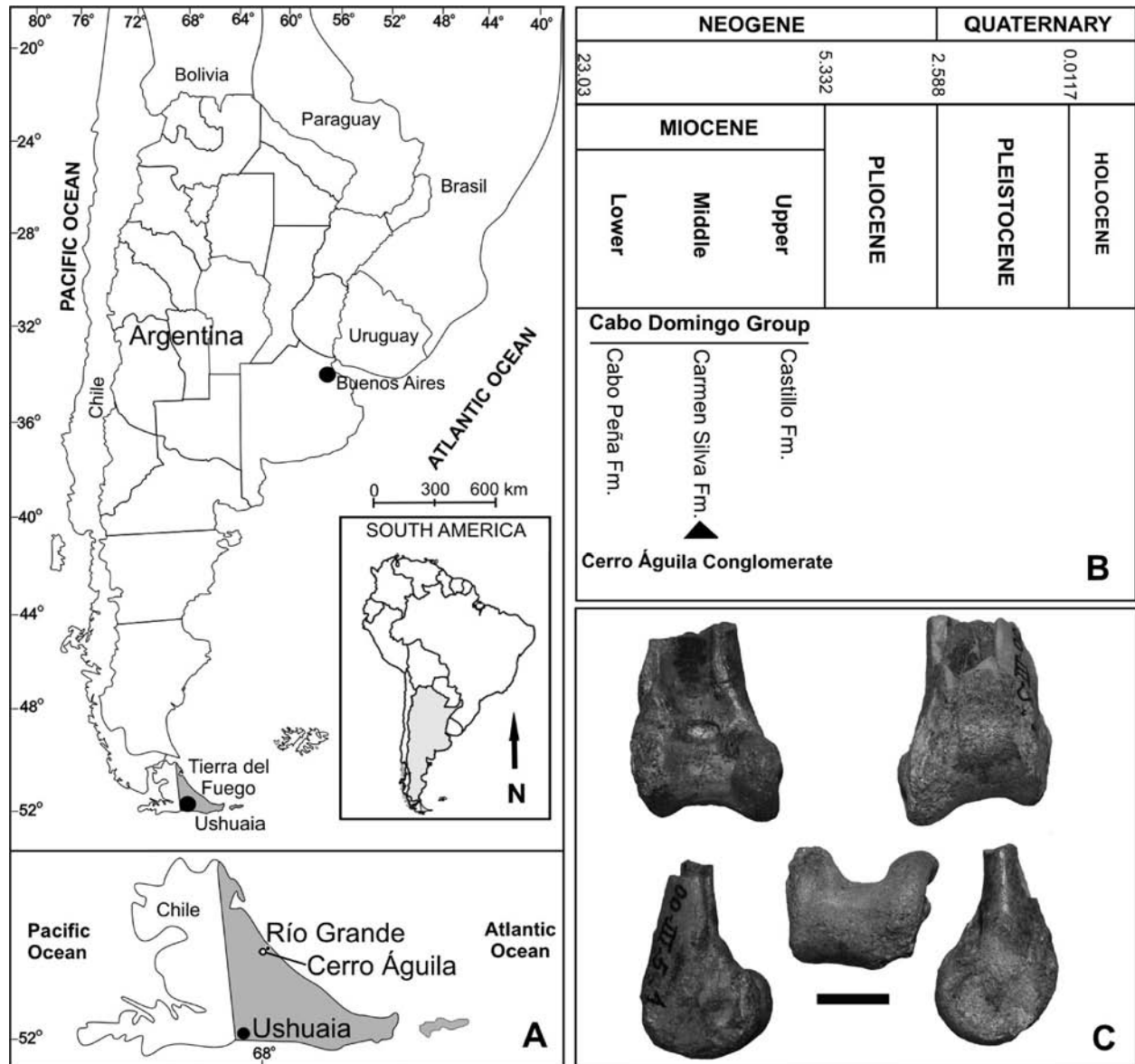


Fig. 1. A – Map depicting the location of Cerro Águila. B – Time scale and formations mentioned in the text. C – MLP 00-III-5-1, distal epiphysis of a right tibiotarsus: cranial aspect (above, left), caudal aspect (above, right), distal view (center), medial aspect (below, left), lateral aspect (below, right). Scale bar equally 10 mm.

Like in *Madrynornis mirandus*, at the lateral surface, there is a slight bony tuberosity that in *S. muizoni* is developed as a weak vertical line. On the contrary, a swollen tubercle for the *retinaculum of the fibularis* muscle forms a bulge in most extant species of *Spheniscus*, *Pygoscelis*, *Eudyptes*, and *Aptenodytes*. In the fossil under study, in *S. magellanicus*, and in *S. chilensis* there is a quite straight distal end of the tibiotarsus provoked by a very weak lateral tubercle for the *retinaculum of the fibularis* muscle.

The tiny foramen near this tubercle is present like in most penguin species (except *Aptenodytes patagonicus*), and laterally located like in *S. muizoni*, *S. magellanicus*, *Pygoscelis papua*, and *P. adeliae*, whereas it is proximal in *S. humboldti* and *S. demersus*.

An acute edge on the lateral condyle is absent, as in *Paraptenodytes* and *Madrynornis*. The medial condyle is vertical as in *S. muizoni*, and not laterally inclined as in *Madrynornis*, *S. chilensis* and the living species. Unlike

Madrynornis mirandus, *Spheniscus*, and *Eudyptes* in which both condyla are equal in their distal extension, the *condylus medialis* is craniocaudally longer, like in *S. muizoni*. The medial condyle possesses a prominent edge, similar to *Pygoscelis*, *Spheniscus* and *Madrynornis*.

The lateral epicondylar depression is absent, whereas in *Paraptenodytes* has a little development. The medial epicondyle is scarcely proximodistally elongated, in *Madrynornis* is craniocaudally elongated, and it is rounded and prominent in the extant compared species. Both condyla are parallel, while they are proximally convergent in *Paraptenodytes antarctica*.

The extensor groove is positioned centrally as in *Spheniscus* and *Madrynornis*, whereas it is lateral in *Aptenodytes*. The supratendinal bridge is proximodistally narrow, like in *Perudyptes* and *Paraptenodytes* among fossil species. In *Madrynornis*, *S. muizoni* and the living penguins, this bridge is proximodistally wider.

Remarks: Comparison cannot be made with *Eretiscus*, *Palaeospheniscus* and *S. megaramphus* because their tibiotarsi remain unknown.

Measurements (in mm): Distal width MLP 00-III-5-1: 20.03, *Madrynornis mirandus* (MEF-PV 100) 16.9, *S. muizoni* (MNHN 147) 14.5, *S. urbinai* (MUSM 401) 23.3, (MUSM 402) 23.4, *S. chilensis* (UF 144150) ca.15, *Paraptenodytes* (MLP M619 cast from AMNH 3338) 23.8, *Spheniscus magellanicus* (MLP 873) 13.7, *Pygoscelis antarctica* (MLP 470) 15.8, *Pygoscelis papua* (MLP 38) 14.5, *P. adeliae* (MLP 464) 13.6, *P. grandis* (SGO.PV 1104) ca. 29.0, and *Eudyptes* (MLP 39) 13.8.

5. Discussion and conclusions

The specimen MLP 00-III-5-1 is the southernmost penguin yet recorded in the Miocene of South America. At these latitudes, the only other fossil penguin known belongs to an Eocene representative of Pansphenisciformes (see CLARKE et al. 2003), or of Sphenisciformes using the traditional systematic scheme (WILLIAMS 1995).

Two characters of the tibiotarsus were evaluated by CLARKE et al. (2007) for the elaboration of their phylogenetic proposal. The first one (character 168, CLARKE et al. 2007) is concerned to the crista patellaris, that unfortunately cannot be studied in the MLP 00-III-5-1 because it was not preserved. The other character indicates the degree of the shaft flattening at the middle portion (character 169, CLARKE et al. 2007), that was not preserved in the MLP 00-III-5-1 either.

Nevertheless, the morphology of the MLP 00-III-5-1 is consistent with those of the tibiotarsi of the Neogene penguins from South America, allowing its allocation to the Family Spheniscidae.

This record is particularly interesting for the group study, as it provides new data for understanding the

evolutionary and palaeobiogeographic history of the penguins. It is the only Neogene record of a penguin for these latitudes, constituting a starting point for the comprehensive analysis of the Pacific and Atlantic spheniscofauna.

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